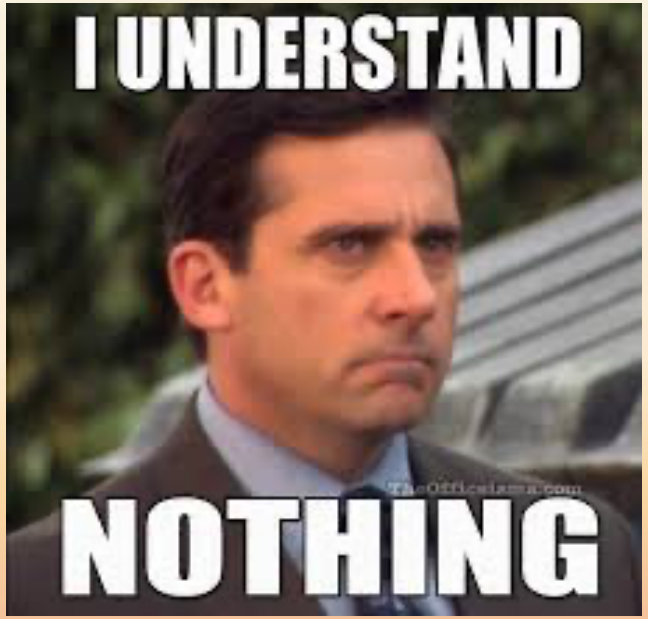
rstudio::conf(2020L)

List-columns in data.table

Tyson S. Barrett

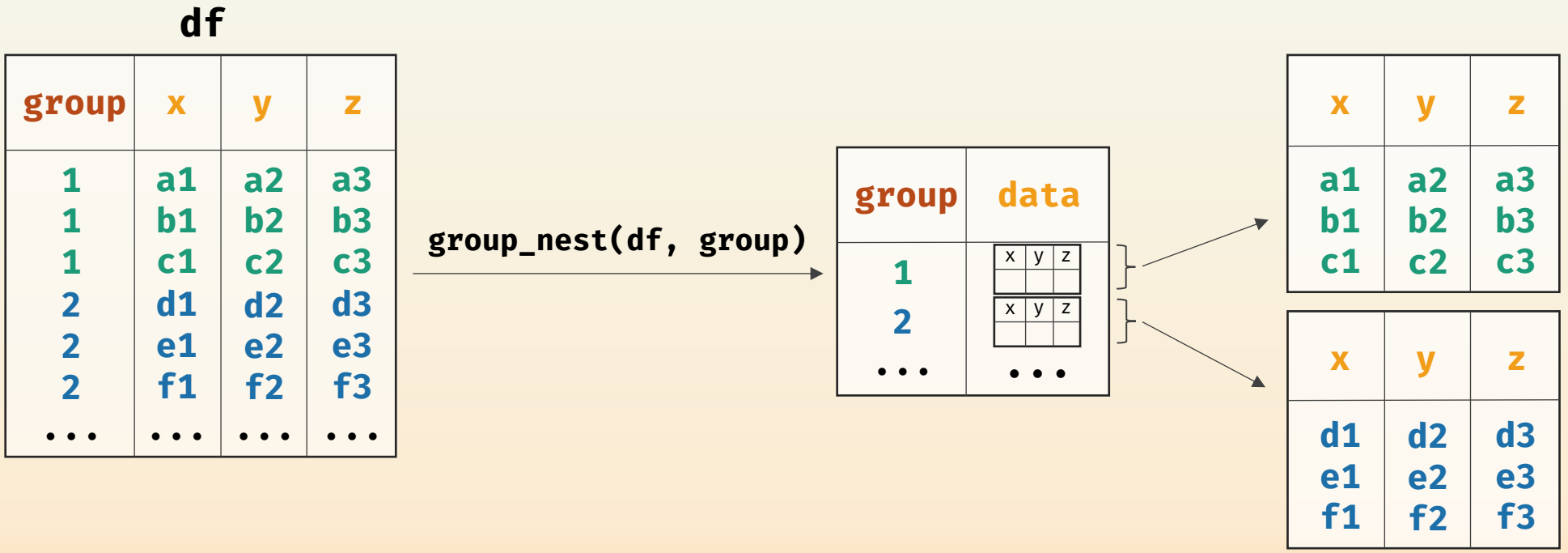
Artwork from @juliesquid for @openscapes
(illustrated by @allison_horst)




```tidyverse
library(tidyverse)
df %>%
  filter(x == 1) %>%
  mutate(z = y * 2)
```

```data.table
library(data.table)
dt[x == 1][, z := y * 2]
```

What are list-columns?



Great question!

Has several functions in the `#tidyverse`

Can make data manipulations safer

Memory efficient (fewer redundancies)

Cognitively easier to understand complex data

Show up all over the place (e.g. `bench::mark()`)

Why data.table?

Concise syntax

Fast speed

Memory efficient

Careful API lifecycle management

Community

Feature rich

*According to the GitHub README

Why data.table?

- Concise syntax
- Fast speed
- Memory efficient

Careful API lifecycle management

Community

Feature rich

*According to the GitHub README

Why data.table?

Concise syntax

Fast speed

Memory efficient

Careful API lifecycle management

Community

Feature rich

```
dt[i, j, by]
```

"filter" or "arrange"

"mutate"

"group_by"

*According to the GitHub README

Why data.table?

Concise syntax

Fast speed

Memory efficient

Careful API lifecycle m

Community

Feature rich

Responding to why `data.table` is so fast, Hadley Wickham:

"I think it's a relentless focus on performance across the entire package."

https://twitter.com/hadleywickham/status/1153850194892640256

*According to the GitHub README

Why data.table?

Concise syntax

Fast speed

Memory efficient

Careful API lifecycle

Community

Feature rich

https://h2oai.github.io/db-benchmark/

Summing by group

Input table: 1,000,000,000 rows x 9 columns (50 GB)

data.table	1.12.9	2019-12-12	1339s
(py)datatable	0.10.0a0	2019-11-24	2682s
dplyr	0.8.3	2019-12-05	timeout
pandas	0.25.3	2019-12-07	out of memory
spark	2.4.4	2019-12-05	not yet implemented
dask	2.9.0	2019-12-07	timeout
DataFrames.jl	0.20.0	2019-12-09	out of memory
ClickHouse	19.16.2.2	2019-12-09	CH server crash
cuDF	0.10.0	2019-12-05	out of memory
Modin		see README	pending

*According to the GitHub README

Let's Team Up

rstudio::conf(2020L)

The Grammar

Nest making a list-column of data tables or vectors

Unnest unnesting list-columns that have data tables or vectors in them

A Brief Example!

Data from:

- Statistica
- dplyr::starwars

```
library(tidyverse)
library(data.table)
```

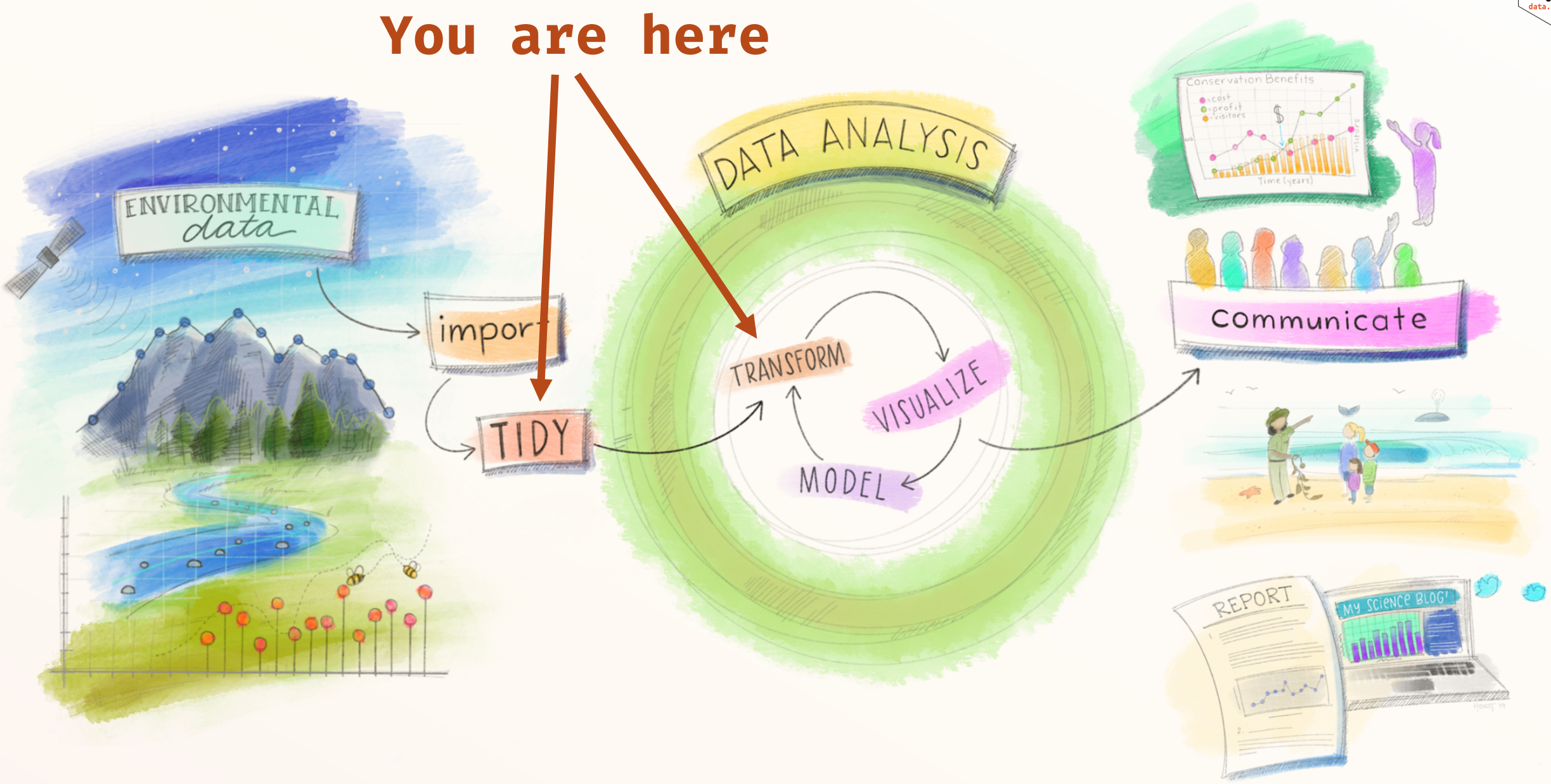
Note, the following approaches work with the current developmental version (1.12.9)

The Data Sets

```
##      name                 species homeworld films      ...
##      <chr>                <chr>   <chr>     <list>     
## 1  Luke Skywalker       Human   Tatooine  <chr [5]>  ...
## 2  C-3PO                Droid   Tatooine  <chr [6]>  ...
## 3  R2-D2                Droid   Naboo     <chr [7]>  ...
## ...
```

```
##   films                      revenue
##   <char>                       <num>
## 1 A New Hope                   775.4
## 2 The Empire Strikes Back      538.4
## 3 Return of the Jedi           475.1
## 4 The Phantom Menace          1027.0
...
```

You are here


ENVIRONMENTAL data
import
TIDY
DATA ANALYSIS
TRANSFORM
VISUALIZE
MODEL
Communicate
Conservation Benefits
cost
profit
visitors
Time (years)
REPORT
My Science Blog!

First, let's unnest

The variable `films` is currently a list-column of character vectors

```
sw <- as.data.table(dplyr::starwars)
sw <- sw[, .(films = films[[1]]),
           by = c(...))
```

First, let's unnest

The variable `films` is currently a list-column of character vectors

```
sw <- as.data.table(dplyr::starwars)
sw <- sw[, .(films = films[[1]]),
           by = c(...))
```

The list-column

Other variables we want to keep in the data e.g. "name", "species"

First, let's unnest

The variable `films` is currently a list-column of character vectors

```
sw <- as.data.table(dplyr::starwars)
sw <- sw[, .(films = films[[1]]),
           by = c(...))
```

```
##                 name                          films    ...
##               <char>                         <char>    ...
##  1: Luke Skywalker      Revenge of the Sith    ...
##  2: Luke Skywalker       Return of the Jedi    ...
##  3: Luke Skywalker The Empire Strikes Back    ...
##  ...
```

Then, let's nest by film

Creates a variable called data with all the data associated with each film

The data table

Name of new list column

```
swn <- sw[, .(data = list(.SD)),
          by = films]
```

Symbol for *Subset of the Data*

Tell it to make the list-column by each film

The Nested Data

```
##     films                          data
##     <char>                         <list>
## 1: A New Hope                      <data.table>
## 2: Attack of the Clones            <data.table>
## 3: Return of the Jedi              <data.table>
## 4: Revenge of the Sith             <data.table>
## 5: The Empire Strikes Back         <data.table>
## 6: The Force Awakens               <data.table>
## 7: The Phantom Menace              <data.table>
```

Joining Revenue with Nested

```
# join nested and revenue on films variable
swn <- swn[revenue, on = "films"]
swn[]
```

```
##     films                 data           revenue
##     <char>                <list>           <num>
## 1: A New Hope         <data.table>   775.4
## 2: The Empire  ... <data.table>   538.4
## 3: Return of   ... <data.table>   475.1
## 4: The Phantom ... <data.table>  1027.0
## ...
```

Some analyses...

(Get counts of different species per film; Could use dtplyr here instead)

```
# Get counts for each film from the data column
swn[, counts := purrr::map(data, ~count(.x, species))]
swn[]
```

Forces the print method

Creates a list column called "counts" of tibbles with count data by gender

Some analyses...

(Get counts of different species per film; Could use dtplyr here instead)

```
# Get counts for each film from the data column
swn[, counts := purrr::map(data, ~count(.x, species))]
swn[]
```

Note, no name because
unnesting a data table

```
swun <- swn[, counts[[1]],
            by = .(films, revenue)]
swun[]
```

The Unnested Data

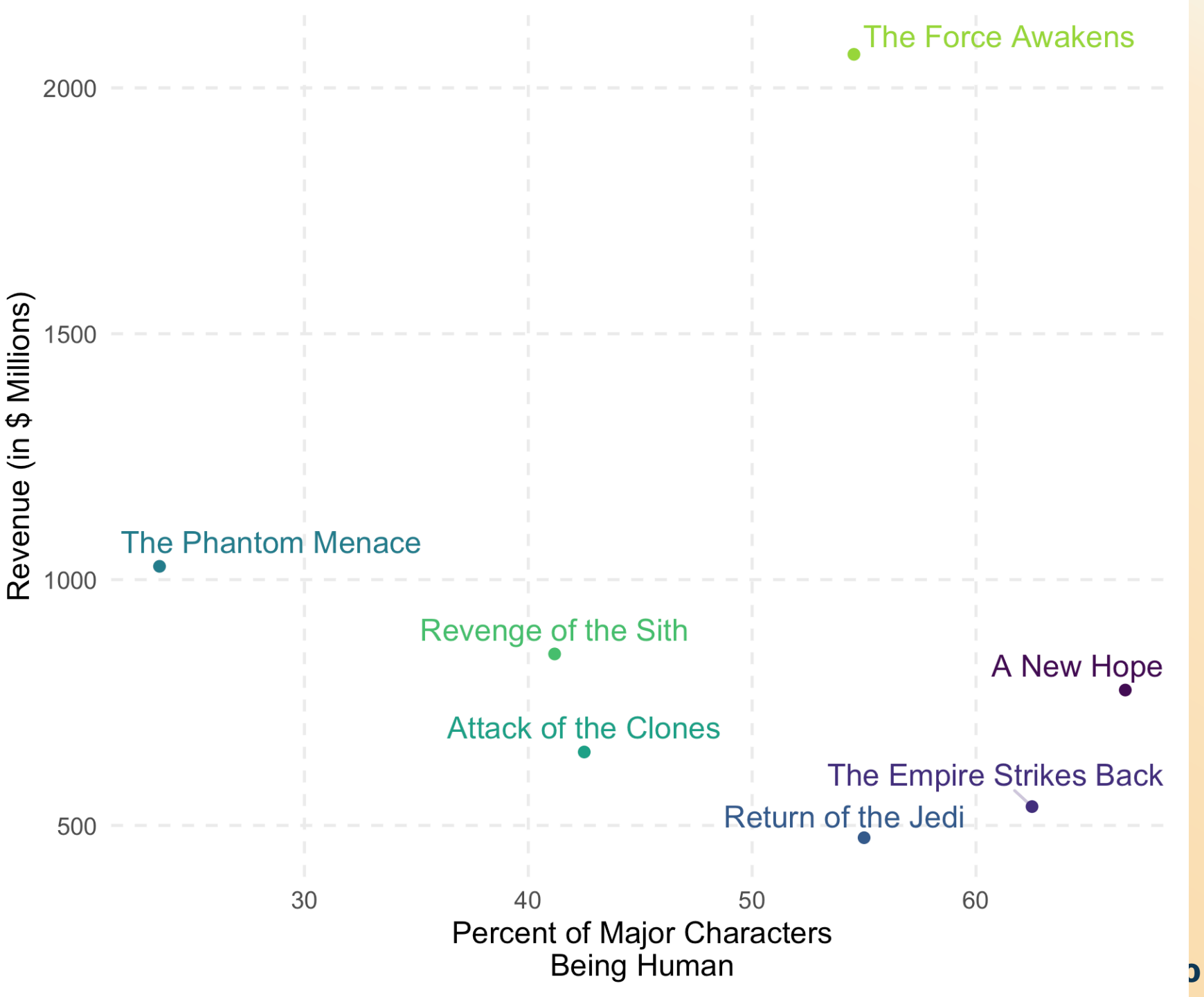
```
##          films  revenue  species     n
##         <char>    <num>   <char> <int>
## 1:  A New Hope    775.4    Droid     3
## 2:  A New Hope    775.4    Human    12
## 3:  A New Hope    775.4     Hutt     1
## 4:  A New Hope    775.4   Rodian     1
## 5:  A New Hope    775.4  Wookiee     1
## ...
```

From here, we can get the proportion of females to all characters and check the relationship between proportion and revenue

The

```
##
##
## 1:
## 2:
## 3:
## 4:
## 5:
## ..
```

From here
the relatio



Cool, cool...

But what about performance?!

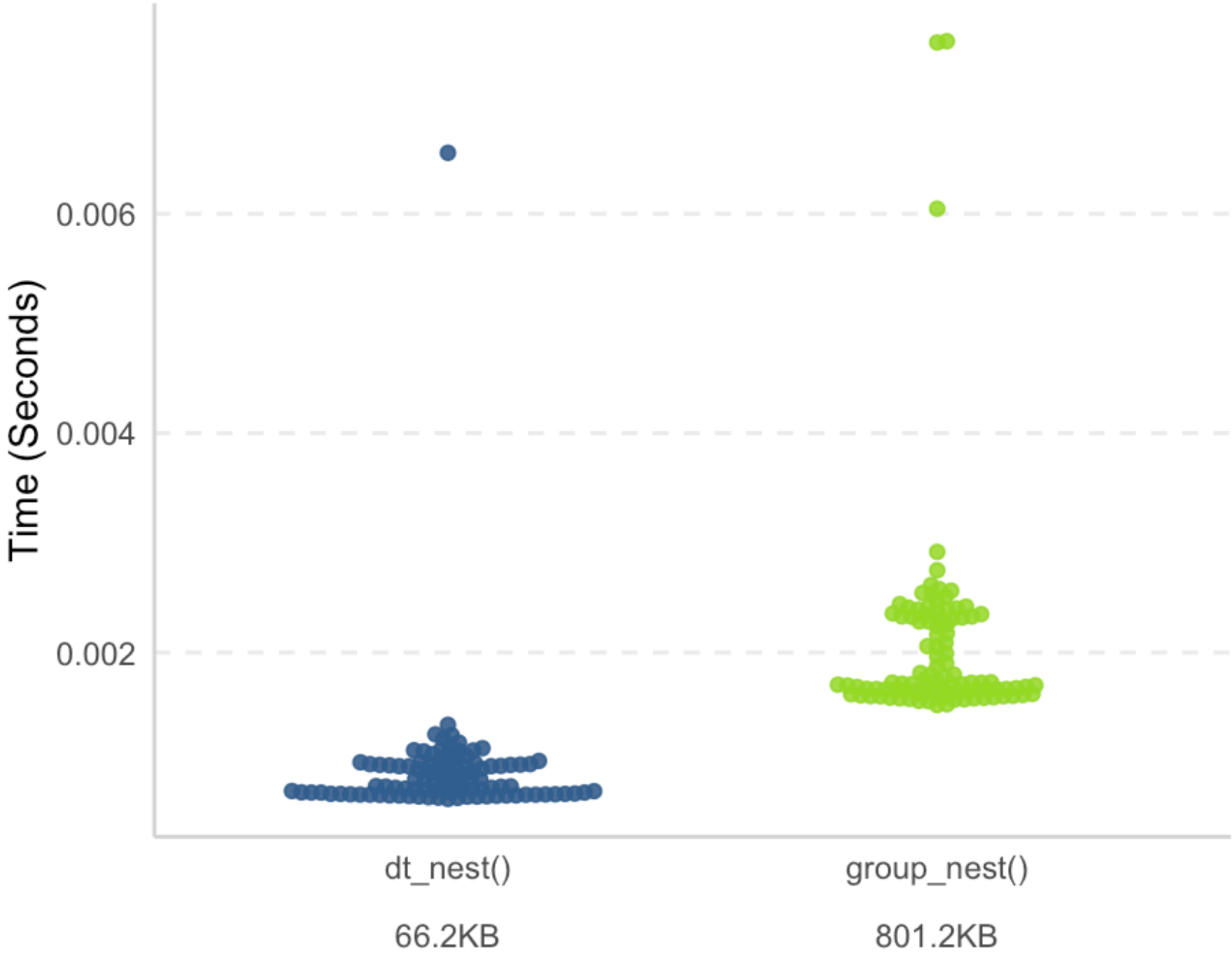
```
library(tidyfast)
```

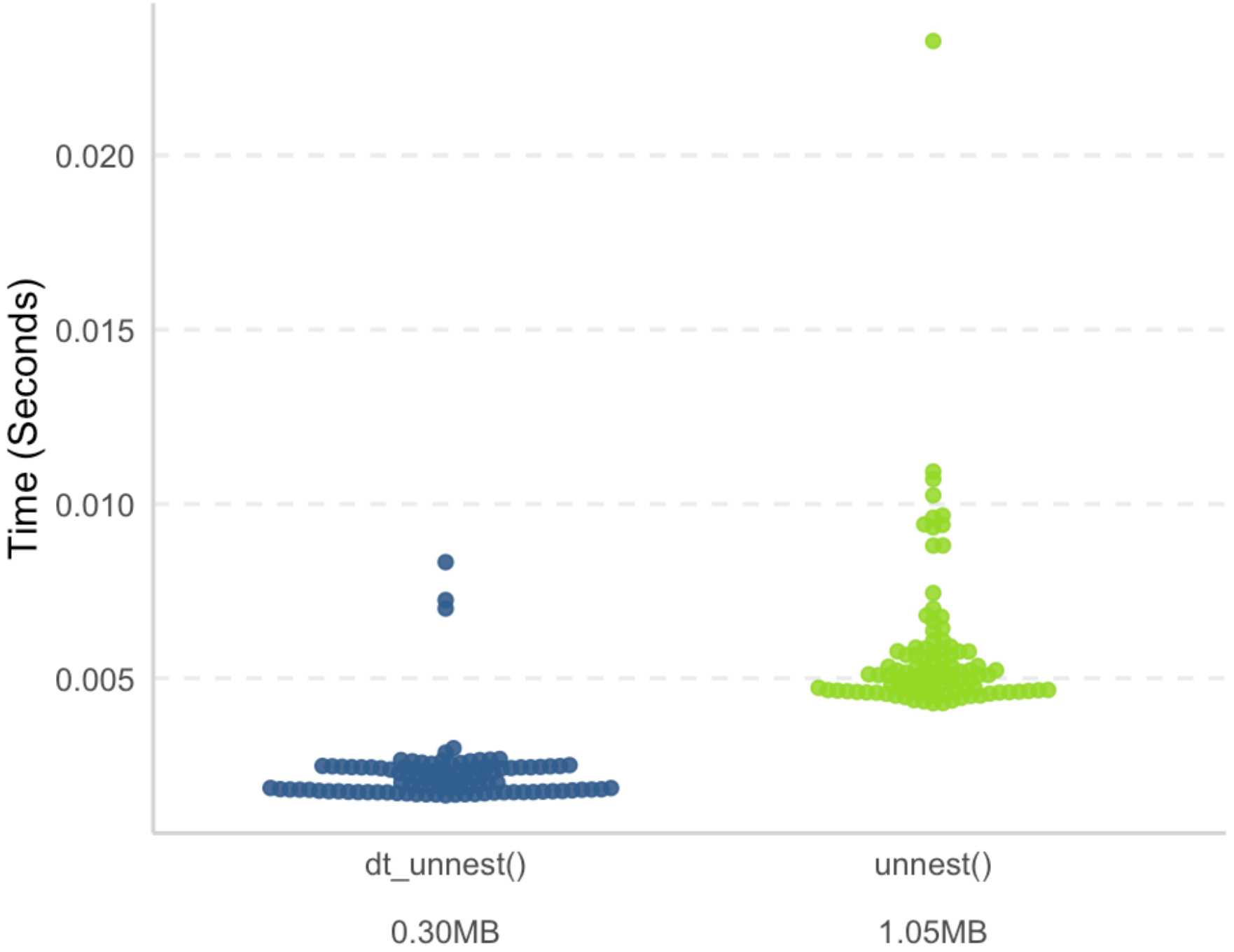
Packaged up the functions into tidyfast

```
remotes::install_github("tysonstanley/tidyfast")
```

Cool, coo
But what

Nesting




Time (Seconds)
0.020
0.015
0.010
0.005
dt_unnest()
0.30MB
unnest()
1.05MB

Unnesting

Tyson S. Barrett

Thanks to Matt Dowle and Arun Srinivasan and the data.table team!

 tyson.barrett@usu.edu

 tysonbarrett.com

 @healthandstats

 github.com/tysonstanley

 Slides at tysonbarrett.com/teaching